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THESIS

REFINED MARINE CORPS CONTRACT SUPPLY MODEL FOR HIGH-QUALITY MALE ENLISTMENTS AT THE RECRUITING SUB STATION LEVEL

by

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March 2009

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REFINED MARINE CORPS CONTRACT SUPPLY MODEL FOR HIGH-QUALITY MALE ENLISTMENTS AT THE RECRUITING SUB STATION LEVEL

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The objective of this research is to further develop and refine an existing model for forecasting the supply of high-quality male contracts at the Recruiting Sub Station level for the Marine Corps. Additional variables that were excluded in the previous model will be researched and incorporated to provide a more realistic scenario for the Marine Corps Recruiting Command. This follow on research is necessary because of the rising accession missions and increasing recruiter levels. It is our intent that this forecasting information will facilitate recruiting efforts as end strength increases over the course of the next two years.

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We will begin by thanking our wives and children for their support and understanding during the writing of this thesis. For their patience and assistance along the way, we would like to thank our advisors, Professors Stephen Mehay and Elda Pema. Their sage advice and wisdom allowed us to realize our potential and develop a product that will hopefully be of some benefit to the Marine Corps. Additionally, we owe the personnel at the Marine Corps Recruiting Command and the Center for Naval Analyses (CNA) a word of thanks for providing the necessary data for our research. Lastly, we would like to thank the instructors and faculty at the Naval Postgraduate School who went above and beyond to mentor and prepare us for the challenges that lie ahead.

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I. INTRODUCTION

A. BACKGROUND

The Marine Corps has been authorized by Congress, per the recommendation of the President, to increase the active forces[1] end strength[2] to 202,000 by Fiscal Year (FY) 2013. According to the President's 2008 Budget, the Marines are increasing end strength by 14,000 personnel in FY 2008, by 19,000 personnel in FY 2009, by 24,000 personnel in FY 2010, and by 27,000 in FY 2011. The incremental growth of approximately 3,000 personnel per year will have a tremendous effect on recruiting costs and the determination of where to best allocate recruiting resources.

B. PURPOSE

The purpose of this research is to further develop and refine an existing model for forecasting the supply of high-quality male contracts at the Recruiting Sub-Station (RSS) level, which is the lowest level in the Marine Corps Recruiting Command's chain of command. The thesis investigates several new and hopefully more accurate, variables to include in the RSS-level forecasting model. These variables include more accurate civilian wages, veteran population estimates, and advertising expenditures. Where possible these variables are incorporated in the existing model to provide a more accurate prediction model for the Marine Corps Recruiting Command. This research is necessary because of the rising accession missions and increasing recruiter levels. It is our intent that this forecasting model will assist policy makers in their assignment and utilization of scarce recruiting resources as end strength increases over the course of the next two years.

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[1] Active forces are active duty personnel serving during war and peacetime in the Operating Forces. This does not include Marine Corps Reserves.

[2] End Strength is maximum number of personnel a given military service can have at the end of the fiscal year (September 30).

C. SCOPE AND METHODOLOGY

A review of several previous enlistment supply studies was conducted in an effort to isolate the key factors that have been found to be accurate predictors of the production of high-quality male contracts across geographic areas and over time. Although some of the studies discussed other branches of the armed forces and were published almost thirty years ago, they still provided pertinent information as they focused on variables that are believed to directly affect a potential high-quality male's propensity to enlist.

In addition to reviewing previously published studies related to our topic, our methods of completing this thesis included communication with personnel at the Center for Naval Analyses (CNA), the Marine Corps Recruiting Command (MCRC), and the Navy Recruiting Command (NRC). A review of current forecasting models used within the Marine Corps and Navy was done. We compiled data on United States Marine Corps and Department of Defense contract production and then specified and estimated a new Marine Corps contract supply model. We were asked to research the impact an advertising variable would have on predicting high-quality male contracts. This research, however, indicated that advertising data was not available at the desired local geographic levels (RSS). Similarly, we investigated the availability of data to estimate an enlistment supply model at the zip code or county level and have concluded that this would be best suited for follow-on research.

D. ORGANIZATION OF STUDY

Following this introduction, the literature review in Chapter II surveys numerous prior accession studies, the Navy Recruiting Command's contract supply model and a previous Marine Corps contract supply model. These models are examined and the issues relevant to this study are discussed. In Chapter III, a detailed description of our data is provided. Chapter III also discusses how data was obtained, processed, summarized, and arranged in order to estimate our supply model. The model specification is described in detail and further analyzed in our model estimation section in Chapter IV where we define and interpret each variable and the model itself.

Additionally, our proposed hypotheses are addressed. Finally, our thesis closes with a summary of our findings and any recommended areas to be researched that were of interest but outside the scope of this study.

E. CHAPTER SUMMARY

The goal of this thesis is to produce a more dependable and user-friendly model that can be utilized by manpower planners to better forecast high-quality male applicants. This is especially helpful because it will focus the efforts of the recruiting force at the RSS level as it strives to accomplish the goal of increasing force structure over the course of the next two years.

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II. LITERATURE REVIEW

A. PREVIOUS RECRUITING PROGRAM STUDIES

Numerous prior studies have analyzed military enlistment supply models. Many of these studies used pooled time series, cross-sectional data. Pooled data increases the variation in key variables, such as military pay, civilian pay and unemployment, as compared to either cross sectional or time series data alone. (Hogan et al., 2000). The following section discusses some of the key predictive variables which were used extensively in previous studies, which we included in our enlisted supply model.

1. USMC Recruiters

Determining which geographic locations to assign the recently increased number of Marine canvassing recruiters in order to obtain more high-quality male contracts is one of the underlying purposes of further developing this contract supply model. The number of canvassing recruiters on production is one of the few variables in this model that the Marine Corps can control. Various studies on contract supply models have found that, when all other variables are held constant, same-service recruiters have a positive effect on the number of high-quality contracts achieved. Goldhaber's study states that in addition to increasing enlistment rates, recruiters are a "relatively cost effective means of increasing supply" (Goldhaber, 1999).

2. Other Service Recruiters

Numerous studies have looked at the effect of other service recruiters operating in the same geographical area on a given service's recruiting success. The number of other-service recruiters in a given area appears to complement the recruiting efforts of each branch of service. Individual contracts initiated by a recruiter from any branch of service can stimulate and inform eligible individuals about military service in general (Warner, 1990). Research by Hostetler (1998), Jarosz and Stephens (1999), and by Hogan et al. (2000) found that increases in either the Army or Navy recruiting force in a local

geographic area led to increases in other services' high-quality male contracts. The exception to this finding was noted in Warner's (1990) study. He discovered that the Marine Corps was the only branch that did not benefit from additional recruiters from other services operating in their local area of operations. However, in most of the other studies, the presence of recruiters from other branches appears to be complementary to an individual service.

3. Economic Factors: Military-to-Civilian Pay and the Unemployment Rate

According to Warner's 1990 study,

> any analysis of military labor supply must begin with the two basic economic forces that determine military enlistment; (i) military pay relative to civilian wages and (ii) the civilian unemployment rate. (Warner, 1990, p 48).

These have proven to be two of the most predictive factors considered when determining the supply of high-quality male contracts. In each study, higher relative military pay and increases in unemployment rates have been positively correlated with higher rates of enlistment. Warner's results varied by service, but he found that a ten percent increase in relative pay led to an increase in high-quality contracts ranging between 2% and 5%. Warner's results for the civilian unemployment rate estimated that a 10% increase in the civilian unemployment rate resulted in a 4% to 6% increase in high-quality enlistments (Warner, 1990). The Hostetler (1998) and Jarosz & Stephens (1999) studies reported similar results showing a correlation between an increase in the unemployment rate and an increase in high-quality male contracts.

4. Veteran Population

Data on local area veteran population has been compiled by the American Community Survey (VETPOP). The VETPOP is described as follows:

> a household survey developed by the Census Bureau as part of the decennial program. It is a large demographic survey collected throughout the year using mailed questionnaires, telephone interviews, and visits from

> Census Bureau field representatives to about 3 million household addresses annually. Starting in 2005, the VETPOP produced social, housing, and economic characteristic data for demographic groups in areas with populations of 65,000 or more. (Prior to 2005, the estimates were produced for areas with 250,000 or more population.) The VETPOP will accumulate sample over three-year and five-year intervals to produce estimates for smaller geographic areas, including census tracts and block groups. (Bureau of Labor Statistics, 2007)
>
> The definition of a veteran in the VETPOP is as follows:
>
> a person 18 years old or over who has served (even for a short time), but is not now serving on active duty in the U.S. Army, Navy, Air Force, Marine Corps, or the Coast Guard, or who served in the U.S. Merchant Marines during World War II. (http://www.bls.gov/lau/vetpopqa.htm)

The yearly estimates in the VETPOP surveys for the period 2004–2007 show a steady decline in the veteran population by state.

The steady decline of the veteran population in the U.S. is displayed in Table 1. This fairly rapid decline is due to the deaths of veterans who served in World War II.

Table 1. Percent Veteran Population by State

Percentage Veteran Population by State					
State	Census 2000 %	VETPOP 2004 %	VETPOP 2005 %	VETPOP 2006 %	VETPOP 2007%
Alabama:	14.0	12.8	12.1	11.8	11.7
Alaska:	17.0	16.2	16.7	14.6	15.4
Arizona:	15.0	13.4	12.7	12.4	11.9
Arkansas:	14.0	13.6	12.8	12.2	11.8
California:	10.0	8.8	8.6	8	7.7
Colorado:	14.0	12.5	11.9	11.7	11.4
Connecticut:	12.0	10.3	10.2	9.7	9.2
Delaware:	14.0	13.5	12.8	8.5	11.9
District of Columbia:	10.0	8.8	7.9	12.3	7.2
Florida:	15.0	13.5	12.9	12.5	12.1
Georgia:	13.0	11.1	11.4	10.7	10.2
Hawaii:	14.0	12.2	12.7	12.4	12.9
Idaho:	15.0	13.4	13	12.5	12.1
Illinois:	11.0	9.5	9.3	8.8	8.3
Indiana:	13.0	11.3	11.2	10.9	10.3
Iowa:	13.0	11.5	11.4	11.2	11

Kansas:	14.0	12.5	12	11.4	11.2
Kentucky:	13.0	11.3	11.1	10.7	10.4
Louisiana:	12.0	11.2	10.4	10.2	9.8
Maine:	16.0	14.5	14.5	13.7	13.8
Maryland:	13.0	12.2	11.9	11.2	10.9
Massachusetts:	12.0	9.9	9.6	9.1	8.7
Michigan:	12.0	11.1	10.7	10.1	9.8
Minnesota:	13.0	11	10.8	10.5	10.3
Mississippi:	12.0	11.1	10.9	9.9	10
Missouri:	14.0	12.8	12.5	12	11.5
Montana:	16.0	15.1	14.3	14.2	14
Nebraska:	14.0	12.5	12.2	11.5	11.3
Nevada:	16.0	13	13.3	12.8	12.3
New Hampshire:	15.0	13.2	13.4	12.9	12.1
New Jersey:	11.0	8.7	8.6	8	7.5
New Mexico:	15.0	13.2	12.8	12.3	12.2
New York:	10.0	7.9	7.8	7.4	7
North Carolina:	13.0	12	11.6	11.4	10.8
North Dakota:	13.0	11.9	12.4	11.8	11.2
Ohio:	14.0	12	11.7	11.1	11
Oklahoma:	15.0	14	13.3	12.5	12.1
Oregon:	15.0	12.9	12.9	12.4	12.1
Pennsylvania:	14.0	12.1	11.9	11.2	10.8
Rhode Island:	13.0	11.8	11.3	9.9	9.8
South Carolina:	14.0	13	13	12.2	12
South Dakota:	14.0	13.6	12.2	12.6	12.6
Tennessee:	13.0	11.7	11.6	11	10.9
Texas:	12.0	10.5	10.1	9.8	9.4
Utah:	11.0	9.3	8.5	8.8	8.5
Vermont:	14.0	13.2	12.3	11.3	11.3
Virginia:	15.0	14.2	13.9	13.5	13.1
Washington:	15.0	13.7	13.6	13	12.7
West Virginia:	14.0	13.8	12.6	12.5	12
Wisconsin:	13.0	11.3	10.9	10.6	10.5
Wyoming:	16.0	14.1	14.6	13.9	13.1

Despite the decreased number of veterans, this demographic is very important for recruiters. These veterans serve as influencers for potential high-quality male applicants. For example, Hojnowski writes:

> The high correlation between veteran population and the propensity of youth to join military service has been repeatedly shown through studies conducted during the AVF era. Decreased veteran population numbers

> could potentially result in lower predictive capability of the model in future years if the variability of these numbers across regions is also reduced. As a result, continued research must be conducted to determine the factors which most affect those in the target youth population so that not only CNRC's goaling model, but recruiting efforts in general can be focused to meet these new demands. (Hojnowski, 2005)

The importance of this group of influencers is reflected in the many current recruiting advertising commercials. Television advertisements are focused more on appealing to the veterans and other influencers than targeting the potential high-quality male applicants directly. For example, Donna Miles writes:

> WASHINGTON, Aug. 30, 2005 - Army advertising aimed at parents, teachers, coaches and other adults who influence young people's decisions regarding military service appears to be gaining momentum as part of the overall "Army of One" recruiting campaign, the director of the Army's strategic outreach effort said today. The Army launched four new commercials in April that specifically target adult influencers, an increasing number of whom have never served in the military and don't fully understand it or the benefits of military service, Army Col. Thomas Nickerson, of U.S. Army Accessions Command, said during a joint interview with the Pentagon Channel and American Forces Press Service
>
> The program's goal is for prospective recruits to consider Army service and ideally, to enlist, he said, and for their adult influencers to support, and ideally, to encourage, that decision. "It focuses on providing information to both prospects and influencers and, most importantly, encouraging them to seek more information about the tangible and intangible benefits of military service," Nickerson said. (Army Recruiting Campaign Focuses on Prospects, Influencers, American Forces Press Service, August 30 2005, http://www.militaryconnections.com/news_story.cfm?textnewsid=1651)

Vincent Coppola writes:

> It will also retain "The Few. The Proud. The Marines." slogan. Upcoming efforts will target "influencers" such as veterans, coaches, teachers, counselors and parents. "Our work will address the demands of the millennial generation—young folks who, more than previous generations, have closer relationships with their parents and other role models," said White. An upcoming campaign, "Marines for life," will go beyond the TV ads to target veterans through the Internet, alumni publications and other media. The theme: "You never lost your honor. You never lost your

> courage. You only lost touch. “Another effort (working title: “Proud Parents”) will focus on family members, capitalizing on the Corps’ long tradition of father-to-son enlistments. “We’re mounting a holistic effort to convince these influencers that the Marine Corps is a rewarding experience and a good life choice,” said Nelson. (U.S. Marines Stand Fast at JWT, Adweek, July 1, 2002, http://www.allbusiness.com/marketing-advertising/4197200-1.html)

5. Advertising

According to Warner’s 1990 study about military recruiting programs during the 1980s, the only service for which he consistently observed a positive recruiting effect of advertising expenditures was the Army. As Warner notes, a complicating factor in using advertising expenditures in enlistment supply models is that the two variables may be simultaneously determined.

> The insignificant or negative estimates for the other services may reflect the endogeneity of these services’ advertising and thus should be regarded with some suspicion. However, Dertouzos (1989) also was unable to find a positive effect for Navy and Marine Corps advertising. (Warner, 1990, p 59)

For example, the Navy Recruiting Command (NRC), describes advertising as “Ill-behaved” or “challenging data” because the coefficient of advertising in the Navy’s econometric contract supply models often is insignificant or the sign is difficult to interpret. According to NRC analyst, Mr. Rudy Sladyk, NRC’s advertising spending variable moves inversely with recruiting success. When Navy recruiters are successful, money is taken away from advertising, but when Navy recruiting becomes difficult, more money is spent on advertising. Because the results of including an advertising variable in the contract supply model are counterintuitive, the Navy does not include an advertising variable in their enlistment prediction model. (Sladyk, 2008). The Goldhaber study also concludes that endogeneity exists because of “the possibility that there is a correlation between the advertising variable and the error term” (Goldhaber, 1999).

B. NAVY ENLISTED GOALING MODEL

1. The Navy's Current Contract Supply Model

> *The beginning of the enlistment supply driven studies occurs around 1970, in support of the President's Commission on an All-Volunteer Armed Force.* (Goldberg, 1983).

The genesis of the Navy's Enlisted Goaling Model came from these early studies. When the draft was replaced by the All-Volunteer Force in 1973, the Navy was already making inroads to develop an econometric model that would enable it to predict which factors contribute to high-quality male enlistments. The Navy's model was further refined by the latter half of the 1970s after it had compiled an ample amount of historic demographic data on the All-Volunteer Force. This data established the foundation for the well-functioning model now used (Welsh, 2008).

The primary target recruiting demographic used in the Navy's model is the number of high school diploma graduates who scored above the 50th percentile (in Categories I through IIIA) on the Armed Forces Qualification Test (AFQT). The Navy refers to someone in this demographic as an "A-cell" contract. There are a number of reasons why A-cell contracts are so desired by the Navy and for that matter, all of the services. One reason is this demographic group is the most costly for the Navy to recruit (due to the time and resources necessary to recruit them). They are considered "supply constrained" as compared to other groups such as category IIIB's and non-high school graduates. However, they offer the biggest potential benefit to the services and afford the greatest flexibility for its manpower planners. This is because the A-cell contract has "the highest program qualification rate, the lowest first-term attrition, the lowest training costs, fewer discipline problems, and best career performance" (NCRC Goal Brief, 2007).

In order to forecast contract production for this key group, the Navy's model predicts Male A-cell production as a function of: past production; recruiters; unemployment rates; relative military pay; Male HSDG 1-3A population; enlistment bonus; other service recruiters; seasonality and other Naval Recruiting District (NRD)

factors to include net contract objective (Sladyk, 2008). The Navy's addition of the variable net contract objective represents the demand the Navy places on their districts to contract a certain number of qualified applicants each month.

The relative predictive accuracy of the Navy's Goaling Model stimulated interest in the Marine Corps to develop a similar contract supply model. According to a recent study conducted by Hojnowski (2005), the difference between the number of predicted and actual contracts in the Navy's model was only 5.31%.

The Navy's model is tailored to work at the NRD level, which is the equivalent of the Recruiting Station (RS) for the Marine Corps. However, the Marine Corps is interested in a forecasting model that is tailored to work at a lower tier in the Marine Corps Recruiting Command's chain of command, specifically, at the recruiting sub-station (RSS) level. A Marine Corps RSS is the equivalent of the Navy's recruiting stations, which represent the local area recruiting office (Sladyk, 2008).

C. MARINE CORPS RECRUITING COMMAND ORGANIZATIONAL STRUCTURE

The Commanding General of the Marine Corps Recruiting Command is responsible for all subordinate Marine recruiting commands throughout the United States. There are four subordinate levels of command. The areas of responsibility (AOR) are divided first into two geographic regions, Eastern Recruiting Region (ERR) and Western Recruiting Region (WRR). The Commanding General at each region is responsible for three Marine Corps Recruiting Districts. ERR is responsible for 1st, 4th, and 6th MCD. The Commanding General of WRR is responsible for 8th, 9th, and 12th MCD. Each of the six MCD commanders has eight Recruiting Stations (RSs) within their AOR. There are over six hundred Recruiting Sub-Stations (RSSs) or local recruiting offices throughout the U.S.

The number of RSSs assigned to each of the forty-eight RS commanders will vary depending on the geographic size of their AOR. This study will focus on the lowest level within the Marine Corps Recruiting Command's organizational structure. The average RSS is manned by five recruiters. On average, four of the five recruiters are

considered production recruiters and one is a non-production recruiter (MCRC Production Recruiters, 7 July 2008). The MCRC Areas of Operation are illustrated in Figures 1 and 2.

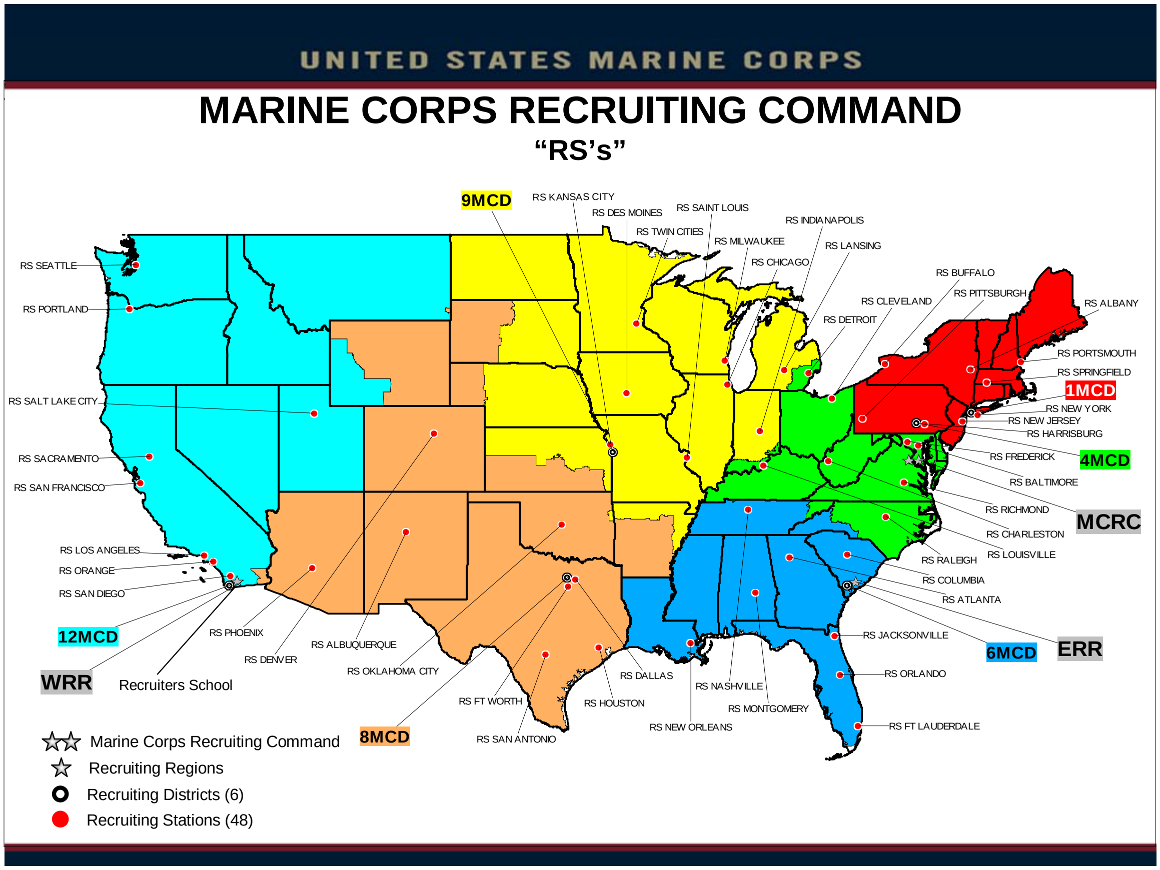

Figure 1. MCRC Area of Operation (RS Level) 2007 Brief

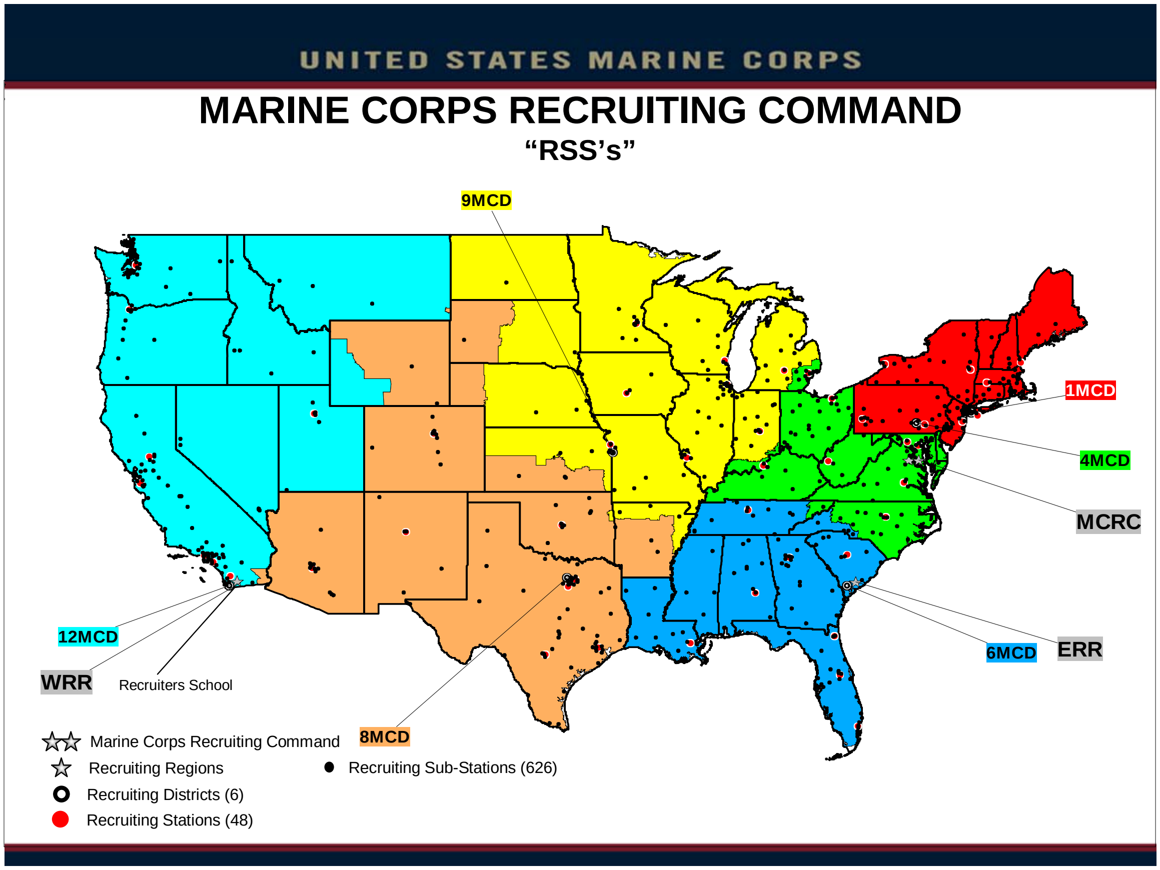

Figure 2. MCRC Area of Operation (RSS Level) 2007 Brief

D. CHAPTER SUMMARY

Since the advent of the All-Volunteer Force (AVF) in 1973, the various military branches have sought to determine what factors contribute to high-quality males' decisions to enlist in the military. Numerous researchers have conducted studies on this subject and the pertinent factors they selected have facilitated the creation and further refinement of forecasting models that are being utilized today by the services' recruiting planners.

While an increase in the number of USMC recruiters in a geographic location will undoubtedly lead to an increase in high-quality male contracts achieved and is a cost-effective means to obtain these contracts relative to other recruiting weapons, there are many other factors that have a direct effect on the accomplishment of this goal. When

applied to the Department of Defense as an institution, studies have shown that additional other-service recruiters in a local area are complementary to high-quality contracts achieved by a given branch. Economic factors weigh heavily in a young male's decision of whether or not to enlist. When unemployment rates increase and military pay is high, relative to civilian wages, the number of high-quality male contracts also increase. The veteran population is also an important factor. This particular demographic, while a powerful influencer upon potential enlistees, is declining across the U.S.

In an effort to harness their power of influence, many services are now targeting this demographic directly in their televised advertising campaigns. However, the Navy is not currently including the advertising variable in their contract supply model because the coefficient infers that additional increases in advertising will have a negative effect on recruiting, which is counterintuitive. While the Marine Corps is interested in including this variable in its contract supply model, data is not collected at the desired level and, therefore, could not be incorporated into this study.

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III. DATA

The data used in the analysis in this thesis builds upon the data set used by Brian Welsh for his thesis, “Marine Corps Contract Supply Model for High-Quality Male Enlistment Contracts at the Recruiting Sub-Station Level” (Welsh 2008). Welsh’s data set integrated over twenty separate data files from multiple sources including the Defense Manpower Data Center (DMDC), the Bureau of Labor Statistics (BLS), the 2000 Census Report, the Bureau of Economic Analyses (BEA) and the Defense Finance and Accounting Service (DFAS). In addition to Welsh’s data, we incorporated new civilian wage data that was provided to the Marine Corps Recruiting Command (MCRC) by the Center for Naval Analyses (CNA) Corporation, and new veteran population data from the American Community Survey (ACS) for the years 2004 through 2007. The new wage and veteran population variables were then merged into Welsh’s original data set.

The civilian wage data provided by CNA measured usual weekly wages at the state and county level and was based on CPS-ORG files.

One of the new civilian wage variables (wage1) provided by CNA measured average wages for males ages 18-to-25 with a high school degree and no college, who are currently employed and working no less than twenty hours a week. (CNA, Memorandum for the Commanding General, Marine Corps Recruiting Command, 2008).

The second civilian wage variable (wage2) provided by CNA also used CPS-ORG files and was calculated for individual males ages 18-to-25 with a high school degree or some college, who are currently employed and working no less than twenty hours a week. (CNA, Memorandum for the Commanding General, Marine Corps Recruiting Command, 2008). These two wage variables proxy for the opportunity cost of enlisting.

The third new variable (vetpop) represents annual estimates of state-level veteran population levels. Utilizing the Multi-User Detection (MUD) Code provided by MCRC, we sorted data by state, RSS, county, and Federal Information Processing Standards (FIPS), and then replaced twenty-six erroneous FIPS for RSSs in order to align counties

geographically with RSSs. This was done to alleviate potential measurement problems. Next, we collapsed the data to the RSS level and merged with Welsh's file. FIPS (county code), state, and year were utilized as unique identifiers enabling us to merge the new civilian wage data and veteran population estimates with Welsh's original data set at state or county level. The new variables were utilized in the specification of a high-quality male enlistment supply model. Listed below are the descriptions of all data sources that were used in the final analysis data set.

A. MARINE CORPS RECRUITING COMMAND ORGANIZATIONAL STRUCTURE

The Commanding General of the Marine Corps Recruiting Command is responsible for all subordinate Marine recruiting commands throughout the United States. There are four subordinate levels of command. The areas of responsibility (AOR) are divided first into two geographic regions, Eastern Recruiting Region (ERR) and Western Recruiting Region (WRR). The Commanding General at each region is responsible for three Marine Corps Recruiting Districts (MCD). ERR is responsible for 1st, 4th, and 6th MCD, while the Commanding General of WRR is responsible for 8th, 9th, and 12th MCD. Each of the six MCD commanders has eight Recruiting Stations (RSs) within their AOR. The 48 RSs cover over six hundred Recruiting Sub-Stations (RSSs) located throughout the U.S. The number of RSSs assigned to each of the forty-eight RS commanders varies depending on the geographic size of their AOR. This study will focus on the lowest level within the Marine Corps Recruiting Command's organizational structure, the RSS level.

1. Recruiting Sub-Station Data

DMDC provided identifiers for all levels of the recruiting structure. We selected the RSS identifier labeled Multi-User Detection (MUD) Code. The Marine Corps Recruiting Command (MCRC) uses this MUD code, which is generated by DMDC, for the purposes of identifying the individual RSSs and consolidating month and year information on recruiters and contracts by RSS. In most cases, a county is the responsibility of a single RSS. However, in some circumstances, an outlying high school

in the same county may be canvassed by another RSS. This would mean a single county is being covered by more than one RSS. Each county is assigned an individual FIPS code. When more than one RSS shared a single FIPS code, we chose to align the county-level FIPS code with the RSS that canvassed the majority of the high schools therein. In practice, the area of responsibility assigned to an RSS could cross county lines. In theory, however, for our models, we used the county-level FIPS code to identify each RSS territory.[3].

B. RECRUIT MARKETING INFORMATION SYSTEM (RMIS)

The necessity of providing a model to forecast high-quality male applicants at the RSS level is heightened as the Marine Corps strives to overcome increased recruiting challenges with a looming 2011 deadline to complete the increase in overall force structure. The Defense Manpower Data Center (DMDC) and the Marine Corps Recruiting Command (MCRC) facilitated the collection of data reported at the RSS-level by granting access to the Recruit Management Information System (RMIS). RMIS, uses and Internet-based version of the Recruit Network mainframe system providing information in Oracle data tables to support recruiting efforts (RMIS Users Guide, 2007).

We extracted the Recruit Marketing Information System (RMIS) file in Welsh (2008), which contained monthly RSS-level recruiter contract and population data for the period October 2002 through June 2007. Figure 3 below lays out the RMIS data merging process (Welsh, 2008, p 19).

[3] The following RSSs in our model were associated with erroneous FIPS codes: Aleutians East and Skagway Hoonah-Angoon, AK, Fulton, AR, Gila and Pima, AZ, Alameda, Napa, Riverside, and San Bernardino, CA, Honolulu and Pearl City, HI, Blaine, ID, Washington, IN, Sanilac and Saginaw, MI, Carver, MN, Greene and Saint Louis, MO, Klamath, OR, Cameron, PA, Bell, TX, Kane, UT, Loudoun, VA, Kitsap, Snohomish, and Yakima, WA.

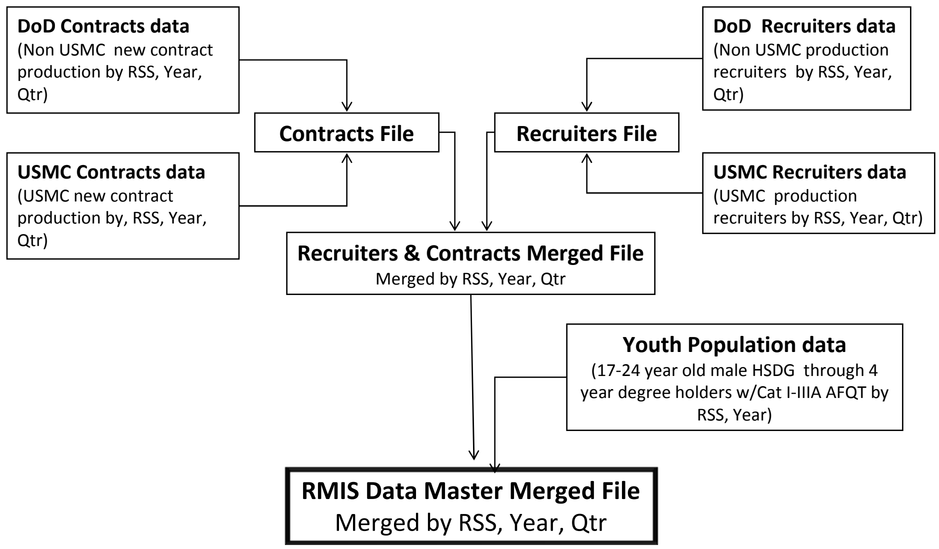

Figure 3. RMIS Merged Data Flow Chart (Welsh, 2008, p 20)

1. Contract and Recruiter Data

Two data files were extracted from RMIS and consisted of Department of Defense (DoD) contract data and DoD recruiters data. Using a year and month identifier in conjunction with the RSS identifier, the contract and recruiter data was merged with the USMC files, provided by MCRC into a single DoD file. The data in this file includes every high-quality male applicant contract signed by year, month, and per RSS for each branch of the armed forces for the period FY03 to the third quarter of FY07 (Welsh, 2008, p 21). However, the second quarter of FY03 and the fourth quarter of FY07 were not available in the RMIS records when this data was extracted.

C. COUNTY-LEVEL DATA

1. Unemployment Rate

The unemployment rate is one of the key factors in predicting the number of high-quality male contracts. For this study, county-level unemployment data for the years 2003 through 2007, by quarter, was retrieved from the Bureau of Labor and Statistics (BLS) website. First, by using a year identifier and a FIPS (Federal Information Processing Standards) state/county code identifier, all data files were merged. The quarterly average of county-level data was sorted by FIPS and then merged for each RSS (Welsh, 2008, p 23).

2. Civilian Youth Population Data

The Department of Defense contracts with Woods and Poole Economics, Incorporated to supply annual estimates of local area population. We extracted these estimates through the RMIS to obtain information on civilian youth population. More specifically, we obtained estimates for 17- to 24-year-old males who scored in Categories I-IIIA on the AFQT. Additionally, at a minimum, this sample had earned a high school diploma, and at a maximum, had taken some college courses. Using MUD codes from FY04 to the third quarter of FY07, the data was consolidated at the RSS level (Welsh, 2008, p 22).

D. STATE-LEVEL DATA

Although the intent was to collect data at the county/RSS level, only state-level data was available for the veteran population and the civilian wages. We merged this state-level information by year to our data.

1. Veteran Population Data

Veteran population data for the years 2004 through 2007 was compiled by the American Community Survey (ACS). The ACS is a household survey developed by the Census Bureau. It is a large demographic survey run annually collecting information on

approximately three million households. Post 2005, social, housing, and economic characteristic data for demographic groups in areas with populations of 65,000 or more were produced by the ACS. (Prior to 2005, the estimates were produced for areas with 250,000 or more population.).[4] From the ACS we extracted the veteran population at the county level (vetpop) and merged it with the rest of our data by state, FIPS code, and year.

2. Civilian Wage Data

Civilian wage data was compiled by CNA for the 18-to 25-year-old male population from 2004 through 2007. All wage measures are based on the CPS ORG files. The Current Population Survey (CPS) is the monthly household survey conducted by the Bureau of Labor Statistics to measure labor force participation and employment. The CPS surveys 50,000 to 60,000 households per month. All households are interviewed each month for four months, then ignored for eight months, then interviewed again for four more months. Usual weekly hours/earnings questions are asked only in the fourth and eighth month interviews. These outgoing interviews (also known as the Outgoing Rotation Group (ORG) files) are used to construct wage estimates. New households enter each month, so one-fourth of the households are in an outgoing rotation each month. CNA used the CPS ORG data to produce year-specific estimates of civilian wages from 2004 through 2007. The sample was limited to males ages 18 to 25, [5] excluding those who dropped out of high school or earned a GED, as well as those who earned a college degree (either a two-year or four-year degree.) CNA included only those who are currently employed. Weights are used to make estimates reflective of the U.S. population. The CPI-U-RS inflation series (Consumer Price Index Research Series Using Current Methods) is utilized to inflate all wages to 2007 dollars. CNA was able to estimate common weekly wages in each case (CNA, Memorandum for the Commanding General, Marine Corps Recruiting Command, 2008).

[4] This information can be obtained at (http://www.bls.gov/lau/vetpopqa.htm).

[5] (National Bureau of Economic Research, www.nber.org/data/morg.html).

E. OTHER DATA: MILITARY PAY

The average entry pay data for pay grades E-1 to E-3 was extracted from annual military pay charts and then calculated for each year for the period FY03 through FY07. Although military pay does not vary, it was collected and merged by year with each data file for the purposes of comparison with civilian pay (Welsh, 2008, p 24).

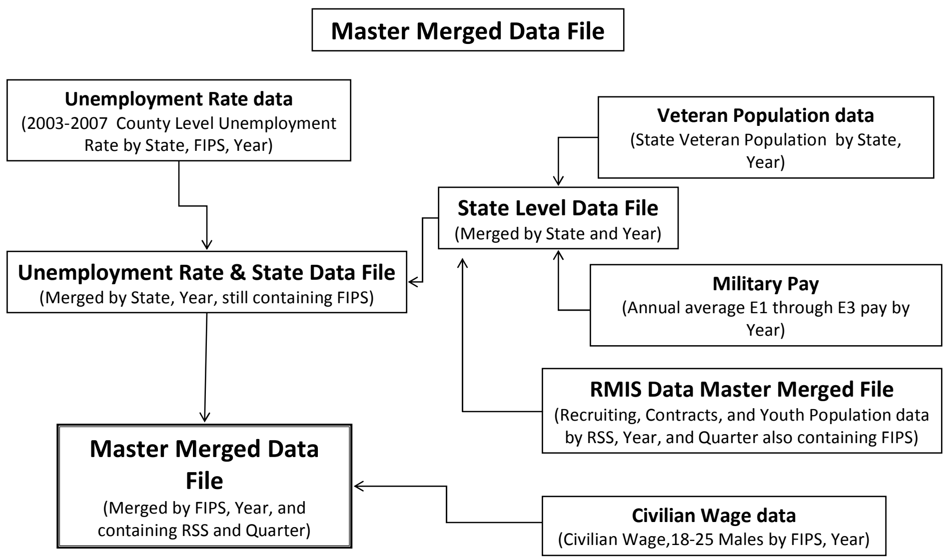

Figure 4. Final Master Data Set Merge Flow Chart

F. VARIABLE DESCRIPTION

The final data file "Master Merged data file" in Figure 4 is used to estimate the econometric supply model. In addition to variables used by Welsh, we added new variables to improve the recruitment predictions. Table 2 contains a list of the key variables and a description of each.

Table 2. Glossary of Variables

Variable Identification Table	
Variable Name	**Description of Variable**
RSS1	Recruiting sub station identifier
year	years 2004 through 2007
qtr	qtrs 1 through 4 within years 2004 through 2007
Dodprodtotal	total number of DoD recruiters
usmcprodtotal	total number USMC recruiters
usmcmalecontracts	total number USMC male contracts 17 to 24-year-old males
usmcallcontracts	total number USMC contracts years 2004 to 2007
youthpop	17 to 24-year-old male High School Seniors through 4 year degree holders scoring in Category I-IIIA on the AFQT by RSS by year
vet_percent	2000 Census veteran population
wage	County Manufacturing Wage average for 2003 through 2006 and State Manufacturing wage for 2007
ur	County Unemployment Rate for 2003 through 2007
wage1avg	State-level wages, 18 to 25-year-old males with a high school degree and no college & employed >= 20 hrs/week
wage2avg	State-level wages, 18 to 25-year-old males with a high school degree or some college & employed >= 20 hrs/week
vetpop	State-level veteran population
milpay	E1 to E3 average annual wage by year 2003 to 2007
wage1avgyearly	State-level wages, 18 to 25-year-old males with a high school degree and no college, annual (avg x 52wks)
wage2avgyearly	State-level wages, 18 to 25-year-old males with a high school degree or some college annual (avg x 52wks)
log_milcivpay1	Natural log of milcivpay1 variable
log_milcivpay2	Natural log of milcivpay2 variable
milcivpay	milpay variable divided by wage variable
log_milcivpay	Natural log of milcivpay variable
log_vet_percent	natural log of veteran_percent variable
log_youthpop	natural log of youthpop variable
log_vetpop	Natural log of vetpop variable
log_ur	Natural log of ur variable

irss1 through 582	Dummy variables for each of the 582 Recruiting Sub Stations
year_2004	Dummy variable for year 2004
year_2005	Dummy variable for year 2005
year_2006	Dummy variable for year 2006
year_2007	Dummy variable for year 2007
qtr_1	Dummy variable for qtr 1
qtr_2	Dummy variable for qtr 2
qtr_3	Dummy variable for qtr 3
qtr_4	Dummy variable for qtr 4
usmcprodtotal_percapita	usmcprodtotal variable divided by youthpop variable
log_usmcprodtotal_percapita	Natural log of usmcprodtotal_percapita variable
dodprodtotal_percapita	dodprodtotal variable divided by youthpop variable
log_dodprodtotal_percapita	Natural log of dodprodtotal_percapita variable
usmcmalecontracts_percapita	usmcmalecontracts variable divided by youthpop variable
log_usmcmalecontracts_percapita	natural log of usmcmalecontracts_percapita variable
usmcallcontracts_percapita	usmcallcontracts variable divided by youthpop variable
log_usmcallcontracts_percapita	Natural log of usmcallcontracts_percapita variable
log_usmcprodtotal	Natural log usmcprodtotal variable
log_dodprodtotal	natural log dodprodtotal variable
log_usmcmalecontracts	Natural log usmcmalecontracts
log_usmcallcontracts	Natural log usmcallcontracts

Using FIPS code and quarter data from the first quarter of FY04 through the third quarter of FY07, all observations were merged by fiscal year to the RSS level. Table 3 presents the summary statistics.

Table 3. Summary Statistics of key variables at the RSS level

Final Consolidated, Post-Collapsed Summary Statistics (Wage1 & Wage2)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
RSS1	8122	291.5276	167.935	1	582
year	8122	2005.5	1.052173	2004	2007
qtr	8122	2.428712	1.115607	1	4
Dodprodtotal	8122	51.89041	23.49741	2.099	237.405
usmcprodtotal	8122	12.86647	5.231171	0.456	52.95
usmcmalecontracts	8122	11.35336	7.295105	0	120
dodprodtotal_percapita	8122	0.1317822	0.1073889	0.0007118	1.172326
usmcprodtotal_percapita	8122	0.0322838	0.0252148	0.0001643	0.2519399
usmcmalecontracts_percapita	8122	0.0286683	0.028315	0	0.6519194
youthpop	8122	604.3662	430.4017	59.11653	3896
ur	8119	5.175517	1.299508	2.15	15.8
wage1avgyearly	8122	24563.14	2083.139	18870.28	39889.2
wage2avgyearly	8122	25538.34	1938.862	20650.24	38001.08
vetpop	8122	10.79197	1.82377	7	16.7
milpay	8122	16007.12	707.4509	15126.3	17178

We were able to successfully merge 8,122 total observations after adding in the new variables and correcting inaccuracies in FIPS codes for twenty-six counties. Missing observations found within the Master Merge Data File were dropped. The remaining 8,122 observations were used to estimate the Marine Corps' Enlisted Supply Model for high-quality male applicants.

Table 3 shows the means of the variables. In each RSS, on average, there are thirteen USMC canvassing recruiters on production and fifty-two recruiters from other services in the same area competing for the same high-quality male contracts. Since on average each RSS has about thirteen production recruiters, each recruiter writes about eleven contracts per quarter. The average unemployment rate is 5.17% and the average yearly state-level wage is between $24,563 and $25,538 depending on the wage estimate used. The USMC canvassing recruiters will have to work hard to convince these potential applicants that serving their country has more benefits beyond the average starting salary of $16,007. The veteran population is also important to recruiters because of its potential

to influence these high-quality male applicants. Approximately 10.79% of the population within a RSS area of operations is made up of veterans.

G. CHAPTER SUMMARY

The data set used in this research combined our new civilian wage variables and veteran population variable with data used by Welsh. Our Master Merge Data File is the result of consolidating data from more than twenty data files from various sources. To accomplish this, we used the RSS variable and a time variable as the unique identifiers. Once all data were merged, the new final data set was utilized to estimate our models.

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IV. MODEL ESTIMATION

The data discussed in Chapter III were used to specify and estimate eight different regression models. This chapter explains the specifications of each model and presents and discusses the results. Our main model is estimated using a fixed effects technique. The model incorporates our two new wage variables and a new veteran population variable and is based upon the original model developed by Welsh (2008).

A. MODELS

In order to discover how specific independent variables affect the number of high-quality male contracts (our dependent variable), we created and analyzed eight different versions of the basic econometric contract supply model. Our first four models use as the dependent variable the number of high-quality male contracts divided by the local (RSS) youth population. Models 5–8 predict total contracts, rather than per-capita contracts. Dummy variables for Recruiter Sub Stations (RSS) were included in some of the models to obtain fixed effects estimates. These RSS dummy variables account for unobserved (to the researchers) local factors and influences that affect recruiting conditions and vary across geographic areas but that are fixed over time. These conditions are not observed and therefore are captured by the error term in models not including dummies for each RSS. If these unobservable factors are correlated with the independent variables, the estimated coefficients can be biased. For example, propensity toward military service is known to vary across geographic areas, but we have no measure of true military propensity. Fixed effects techniques is one method for dealing with the bias that unobserved propensity would induce in recruitment estimates. Each individual model was estimated both with and without fixed effects to determine the robustness of the estimated coefficients (elasticities) to the estimating technique.

B. MODEL SPECIFICATIONS

In our models, the dependent variable was specified as either total Marine high-quality male contracts or as Marine high-quality male contracts per capita of youth

population. The main reason for using the per capita specification is to adjust the model for potential heteroskedasticity arising from high recruitment numbers associated with highly populated areas (Wooldridge, p. 57, 2006). In the latter specification, independent variables that also tend to vary by local area population, such as the number of recruits, also were adjusted by the youth population. We controlled for year and quarter fixed effects in order to take care of fluctuations over time in economic conditions or other variables that affect all RSSs in the same way, as well as seasonal effects, such as length of school year.

The Models are specified in the general equation as depicted in Equation (1):

$$\boxed{N_{i\tau} = \beta * X_{i\tau} + \delta_i + \varepsilon_{i\tau}} \qquad (1)$$

Where $N_{i\tau}$ is the number of high-quality male contracts produced in a fiscal-year quarter, and $X_{i\tau}$ represents a vector of explanatory variables, which include Marine recruiters, other service recruiters, youth population, the unemployment rate, and the military-to-civilian pay ratio. The term δ_i represents the fixed effects, which are accounted for by the RSS dummy variables, and $\varepsilon_{i\tau}$ represents a random error term.

The fixed effects contract supply model is specified in log-log functional form. This model specification is illustrated in Equation (2):

$$\boxed{\begin{aligned}&\log\_\,usmcmalecontracts\_percapita_{i\tau} = \beta_0 + \beta_1 \log(usmcprodtotal\_percapita)_{i\tau} + \\ &\beta_2 \log(dodprodtotal\_percapita)_{i\tau} + \beta_3 \log(ur)_{i\tau} + \beta_4 \log(milcivpay1)_{i\tau} + \beta_5 \log(vetpop)_{i\tau} + \\ &\beta_6 (year\_2005)_\tau + \beta_7 (year\_2006)_\tau + \beta_8 (year\_2007)_\tau + \beta_9 (qtr\_1)_\tau + \\ &\beta_{10} (qtr\_2)_\tau + \beta_{11} (qtr\_3)_\tau + \partial_i \textstyle\sum_i (RSS)_{i=1,\ldots 582} + \varepsilon_{i\tau}\end{aligned}}$$

(2)

Where '*log_usmcmalecontracts_percapita*' is the natural logarithm of high-quality male contracts per capita produced in a fiscal-year quarter, and β_1 through β_{11} represent the coefficients on explanatory variables, which include Marine recruiters per capita, DoD recruiters per capita, the unemployment rate, military-to-civilian pay ratio, and veteran

population. The RSS fixed effects are accounted for by the RSS dummy variables. Year and quarter dummies account for time fixed effects.

The log-log specification yields coefficients that have the elasticity interpretation. More specifically, a one percent change in a particular independent variable (Xi) results in β percent change in the dependent variable, holding all other independent variables in the model constant.

Equation (3) estimates models where the dependent variable represents total quarterly RSS contracts (vice per capita contracts in model (2). Youth population was entered in the model to control for size of the local market area. This specification is shown below:

$$\boxed{\begin{aligned}&\log\_usmcmalecontracts_{i\tau} = \beta_0 + \beta_1 \log(usmcprodtotal)_{i\tau} + \beta_2 \log(dodprodtotal)_{i\tau} \\ &+\beta_3 \log(youthpop)_{i\tau} + \beta_4 \log(ur)_{i\tau} + \beta_5 \log(milcivpay1)_{i\tau} + \beta_6 \log(vetpop)_{i\tau} + \beta_7 (year\_2005)_{\tau} \\ &+\beta_8 (year\_2006)_{\tau} + \beta_9 (year\_2007)_{\tau} + \beta_{10} (qtr\_1)_{\tau} + \beta_{11} (qtr\_2)_{\tau} + \beta_{12} (qtr\_3)_{\tau} \\ &+\delta_i * \textstyle\sum_i (RSS)_{i=1,\ldots 582} + \varepsilon_{i\tau}\end{aligned}} \tag{3}$$

Where '*log_usmcmalecontracts*' of high-quality male contracts produced in a fiscal-year quarter, and β_1 through β_{12} represent the coefficients on explanatory variables as in equation (2).

In our models, RSS-level data on the dependent variable (high-quality male contracts) was collected for 14 quarters from fiscal year 2004 (FY04) through fiscal year 2007 (FY07). Data for the second quarter of FY04 and the fourth quarter of FY07 are missing and were not included in the analysis sample.

C. HYPOTHESIZED EFFECTS

Based on the literature review in Chapter two, increases in the following key variables are expected to have a positive effect on high-quality male contracts: the local unemployment rate, the military-civilian pay ratio, the number of canvassing Marine Recruiters, and the number of military veterans (influencers) residing in the local area. For example, young males are more likely to consider serving in the military when local

unemployment rates increase, opportunities for civilian employment decrease, and when military pay is equal to or better than civilian pay, all else equal. An increase in the number of canvassing recruiters enables the military to contact more eligible candidates for military service. Previous studies have shown that areas with higher veteran populations tend to have a larger number of eligible applicants. Veterans can influence the younger generation to serve in the military.

Quarterly contract data covering a 4-year period 2004-2007 for 582 recruiting sub stations (RSS) was used to estimate all of the models. The final analysis data set contained 8,047 observations. Seventy five observations were lost due to incomplete merges of data. The description of the variables used in estimating the models was presented above in Chapter 3, Table 2, and descriptive statistics were presented in Table 3.

D. DISCUSSION OF MODEL RESULTS

1. Fixed Effects Contract Supply Model with Milcivpay1

We estimate four per capita contract models in order to analyze the recruitment influencers and observe any differences in the supply models when the new wage and veteran population variables are added to the models previously estimated in Welsh (2008). The results of the estimates of the four model specifications are presented in Tables 4, 5, 6, and 7. Table 4 shows the results of the Contract Supply Model that uses the new Milcivpay1 variable.

Table 4. Fixed Effects Contract Supply Model with Milcivpay1(dependent variable = log high-quality male contracts per capita)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal_percapita	0.87527
	(0.01819)***
log_dodprodtotal_percapita	0.01821
	(0.02772)
log_ur	0.04970
	(0.00973)***
log_milcivpay1	0.02645
	(0.01413)*
log_vetpop	0.03158
	(0.02432)
year_2005	0.00066
	(0.00269)
year_2006	0.01465
	(0.00367)***
year_2007	0.02644
	(0.00450)***
qtr_1	-0.00279
	(0.00235)
qtr_2	0.00962
	(0.00260)***
qtr_3	0.03385
	(0.00235)***
Constant	-0.16044
	(0.06372)**
Observations	8047
Number of RSS dummy variables	582
R-squared	0.48

Standard errors in parentheses * significant at 10%;

** significant at 5%; *** significant at 1%

The following key variables have a positive effect on high-quality male contracts: the number of Marine recruiters, the number of other-service recruiters, the unemployment rate, the military civilian pay ratio, and the veteran population. These five variables all have positive coefficients suggesting that increases in these variables will lead to an increased number of high-quality male contracts for the Marine Corps. Specifically, a 1% increase in the USMC recruiters is estimated to increase the high-quality male contracts per local youth population by 0.875%. This is significant at the 1% level. Furthermore, a 1% increase in the unemployment rate is estimated to increase

the high-quality male contracts per local youth population by 0.049% (significant at the 1% level). Lastly, a 1% increase in the military-to-civilian pay ratio is estimated to increase high-quality male contracts per local youth population by 0.026%. This is significant at the 10% level. The estimates in Table 4 confirm that additional recruiters, increased military pay and a higher unemployment rate all contribute to an increase in high-quality male contracts. Although the number of other-service recruiters is positive, it is not significant at any acceptable level. The quarterly data provided in Table 4, confirms that, compared to the fourth quarter of the fiscal year, fewer high-quality male applicants enlist during the second quarter (February through May). Another intuitive finding is that when compared to the fourth quarter, the highest percentages of high-quality male applicants choose to enlist during the third quarter of the fiscal year (June through September), immediately following high school graduation.

2. Contract Supply Model without RSS Fixed Effects

The previous literature suggests that the model specified in Table 4 is the preferred model. However, to test for robustness, the model was re-estimated omitting RSS fixed effects. By eliminating the fixed effects for RSS, the possibility of generating biased results increased because there are no controls for differences in propensity or other unobservables across geographic areas. Table 5 presents the results of the model.

Table 5. Contract Supply Model without RSS Fixed Effects (dependent variable = log high-quality male contracts per capita)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal_percapita	0.87681
	(0.01434)***
log_dodprodtotal_percapita	0.01616
	(0.01234)
log_ur	0.00784
	(0.00388)**
log_milcivpay1	0.02665
	(0.01073)**
log_vetpop	0.04003
	(0.00533)***
year_2005	-0.00280
	(0.00267)
year_2006	0.00746
	(0.00291)**
year_2007	0.01942
	(0.00339)***
qtr_1	-0.00299
	(0.00256)
qtr_2	0.00957
	(0.00284)***
qtr_3	0.03360
	(0.00256)***
Constant	-0.10732
	(0.01740)***
Observations	8047
R-squared	0.50

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

The results in Table 5 are similar to those in Table 4. However, there are some differences between the two sets of results. In particular, the unemployment rate in Table 5 estimates a 1% increase in the unemployment rate is estimated to increase the high-quality male contracts per local youth population by 0.0078%. This is significant at the 5% level. Table 4 estimates a 1% increase in the unemployment rate is estimated to increase the high-quality male contracts per local youth population by 0.049%. This is significant at the 1% level. The change in the magnitude of the effect of the unemployment rate is due to the omission of RSS fixed effects, which must be highly correlated with local economic conditions.

The estimates in Table 5 suggest that a 1% increase in the veteran population will increase high-quality male contracts per local youth population by 0.04%. This is significant at the 1% level. This is a slight change from the 0.03% estimate obtained in Table 4. The change in the size of the coefficient of the veteran population variable suggests that this variable also picks up some of the effect of propensity that was captured by the RSS dummy variables in Table 4.

3. Fixed Effects Contract Supply Model with Milcivpay2

Table 6 shows the results when the second civilian wage variable, milcivpay2, is used instead of milcivpay1 in the basic fixed effects specification in Table 4.

Table 6. Fixed Effects Contract Supply Model with alternative pay variable (dependent variable = log high-quality male contracts per capita)

Variable	Estimate Coefficient (std. error)
log_usmcprodtotal_percapita	0.87542
	(0.01819)***
log_dodprodtotal_percapita	0.01875
	(0.02773)
log_ur	0.04880
	(0.00979)***
log_milcivpay2	0.01563
	(0.01717)
log_vetpop	0.03073
	(0.02432)
year_2005	0.00139
	(0.00269)
year_2006	0.01559
	(0.00375)***
year_2007	0.02781
	(0.00467)***
qtr_1	-0.00280
	(0.00236)
qtr_2	0.00961
	(0.00260)***
qtr_3	0.03385
	(0.00235)***
Constant	-0.16210
	(0.06420)**
Observations	8047
Number of RSS dummy variables included	582
R-squared	0.48

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

The results in Table 6 indicate a 1% increase in the USMC recruiters is estimated to increase the high-quality male contracts per local youth population by 0.875%. This effect is significant at the 1% level. Table 6 also indicates a 1% increase in the unemployment rate is estimated to increase high-quality male contracts per local youth population by 0.0488%. This effect is also significant at the 1% level. In comparison to Table 4 the military-civilian pay ratio maintains a positive coefficient in Table 6 but is not significant at any level below 10%. In Table 4 the coefficient of military-civilian pay

ratio indicates that a 1% increase in the military-civilian pay ratio is estimated to increase high-quality male contract production by 0.026% holding all other variables constant. This is statistically significant at the 10% level. The size of the coefficient drops from 0.02645% in Table 4 to 0.01563% in Table 6, which indicates that including individuals with some college in civilian wage estimation strongly affects the predicted effect of military-civilian pay ratio on high-quality recruitments. In Tables 4 and 6, a 1% increase in the USMC recruiters coefficient results in a 0.88% increase in the number of high-quality male contracts produced (holding all other variables constant) and is significant at the 1% level in both tables. Additionally, a 1% increase in the unemployment rate coefficient results in a 0.049% increase in the number of high-quality male contracts produced (holding all other variables constant) and is significant at the 1% level in both tables.

4. Contract Supply Model without RSS Fixed Effects

When comparing results in Table 7 to results in Table 6, we found the following statistically significant differences in the variables: In Table 6 the coefficient of unemployment rate indicates that a 1% increase in the unemployment rate is estimated to increase high-quality male contracts production by 0.049% holding all other variables constant. This is statistically significant at the 1% level. The size of the coefficient drops from 0.049% in Table 6 to 0.008% in Table 7 where it is statistically significant at the 5% level. The military/civilian pay ratio is not statistically significant in Table 6. However, in Table 7, a 1% increase to the military/civilian pay ratio indicates a 0.023% increase in high-quality male contracts produced holding all other variables constant. This is statistically significant at the 5% level. This indicates that the predicted coefficients of local area variables may be quite misleading when not controlling for RSS fixed effects. The veteran population coefficient, although positive, is not statistically significant at any level below 10% in Table 6. However, in Table 7, a 1% increase in veteran population indicates a 0.04% increase in high-quality male contracts produced holding all other variables constant. This is statistically significant at the 1% level.

Table 7. Contract Supply Model (alternative pay variable) without RSS Fixed Effects (dependent variable = log high-quality male contracts per capita)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal_percapita	0.87697
	(0.01434)***
log_dodprodtotal_percapita	0.01692
	(0.01234)
log_ur	0.00777
	(0.00390)**
log_milcivpay2	0.02363
	(0.01199)**
log_vetpop	0.03978
	(0.00537)***
year_2005	-0.00232
	(0.00266)
year_2006	0.00800
	(0.00291)***
year_2007	0.02004
	(0.00344)***
qtr_1	-0.00300
	(0.00256)
qtr_2	0.00957
	(0.00284)***
qtr_3	0.03360
	(0.00256)***
Constant	-0.10793
	(0.01832)***
Observations	8047
R-squared	0.50

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

5. Fixed Effects Total Contracts Supply Model with Milcivpay1

Unlike the previous four models, the next four models do not adjust contracts or recruiters for local area population size. The dependent variable now consists of total RSS contracts by quarter, by year. The log-log specification is used, and the log of area youth population is entered as an independent variable. Table 8 presents the results.

Table 8. Fixed Effects Total Contracts Supply Model (dependent variable = log total high-quality male contracts)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal	0.87381
	(0.01843)***
log_dodprodtotal	-0.02071
	(0.02840)
log_youthpop	-0.20874
	(0.05640)***
log_ur	0.30395
	(0.05886)***
log_milcivpay1	0.16018
	(0.08551)*
log_vetpop	0.14802
	(0.14715)
year_2005	0.00219
	(0.01629)
year_2006	0.08742
	(0.02224)***
year_2007	0.15838
	(0.02723)***
qtr_1	-0.01756
	(0.01425)
qtr_2	0.05829
	(0.01576)***
qtr_3	0.20480
	(0.01425)***
Constant	0.56782
	(0.51519)
Observations	8047
Number of RSS1	582
R-squared	0.39

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

In this model, as in the population-adjusted model in Table 4, the following key variables had a positive effect on high-quality male contracts: number of Marine recruiters, unemployment rate, military vs. civilian pay, and veteran population. In Table 8, the coefficients of the number of Marine recruiters, youth population and unemployment rate are all statistically significant at the 1% level. Youth population has a negative coefficient which seems puzzling. However, in this model specification the coefficient on youth population represents the effect of population holding constant the number of recruiters. Thus, as population grows, but the number of recruiters is fixed, a

certain percentage of the youth population is not being contacted by recruiters in the RSS. The military-civilian pay ratio (Milcivpay1) has a coefficient that is statistically significant at the 10% level. The coefficient of the number of other-service recruiters, although negative, is not significant at any level below 10%.

When comparing Table 8 to Table 4, we found similarities and differences between the variables. The unemployment rate is statistically significant in both Table 8 and 4 at the 1% level. However, the coefficients for the unemployment rate, the military-civilian pay ratio (Milcivpay1) and the veteran population in Table 8 are larger than they are in Table 4. The coefficient of Marine recruiters in Table 8 was almost a mirror image of the results in Table 4. The coefficient of other-service recruiters is not statistically significant in Table 8, as in Table 4, but it now has a negative coefficient.

In Table 8, the findings for the youth population variable seem counterintuitive. The coefficient of youth population indicates that a 1% increase in the youth population is estimated to decrease high-quality male contract production by 0.021% holding all other variables constant. This is statistically significant at the 1% level. This could be attributed to a youth population growing disproportionately faster than the size of the USMC recruiting force at the RSS level.

6. Total Contracts Supply Model without RSS Fixed Effects

This model is similar to Table 8 but omits RSS fixed effects. The model results are presented in Table 9.

Table 9. Total Contracts Supply Model without RSS Fixed Effects (dependent variable = log total high-quality male contracts)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal	0.88619
	(0.01462)***
log_dodprodtotal	0.01407
	(0.01464)
log_youthpop	0.00889
	(0.00808)
log_ur	0.05045
	(0.02364)**
log_milcivpay1	0.17537
	(0.06523)***
log_vetpop	0.27154
	(0.03304)***
year_2005	-0.02107
	(0.01626)
year_2006	0.04063
	(0.01771)**
year_2007	0.11431
	(0.02062)***
qtr_1	-0.01904
	(0.01559)
qtr_2	0.05873
	(0.01723)***
qtr_3	0.20473
	(0.01557)***
Constant	-0.78513
	(0.13026)***
Observations	8047
R-squared	0.46

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

When comparing Table 9 to Table 8, we find several differences in parameter estimates. Although the estimates for the other-service recruiters in Table 9 are not statistically significant at any level below 10%, they do support the concept of complementary efforts (which is described later in this chapter) between recruiters from different branches of service who operate within the same area. When omitting RSS fixed effects in Table 9 the youthpop variable becomes insignificant, suggesting that local area demographics may be correlated with RSS characteristics and perhaps manning and advertising.

In Table 9, the coefficient of unemployment rate indicates that a 1% increase in the local unemployment rate is estimated to increase high-quality male contract production by 0.05%, holding all other variables constant. This is statistically significant at the 5% level. In Table 8, however, the coefficient of unemployment rate indicates that a 1% increase in unemployment rate is estimated to increase high-quality male contract production by 0.3% holding all other variables constant. This is statistically significant at the 1% level. Again, this suggests the importance of accounting for RSS-level variation unobserved to us, which may be correlated with local unemployment.

In Table 9, the coefficient of military-civilian pay ratio indicates that a 1% increase in the military pay relative to civilian pay is estimated to increase high-quality male contract production by 0.18% holding all other variables constant. This is statistically significant at the 1% level. However, when including RSS fixed effects, a 1% increase in military-civilian pay ratio is estimated to increase high-quality male contract production by 0.16% holding all other variables constant. It is statistically significant at the 10% level.

In Table 9, the coefficient of veteran population indicates that a 1% increase in the local veteran population is estimated to increase high-quality male contract production by 0.27% holding all other variables constant. This is statistically significant at the 1% level. However, in Table 8, when including RSS fixed effects, a 1% increase in veteran population is estimated to increase high-quality male contract production by 0.15% holding all other variables constant. It is statistically insignificant below the 10% level.

7. Fixed Effects Total Contracts Model with Milcivpay2

Table 10 substitutes the wage variable Milcivpay2 for milcivpay1 in Table 8. The dependent variable now consists of total RSS contracts by quarter, by year. The log-log specification is used, and the log of area youth population is entered as an independent variable.

Table 10. Fixed Effects Total Contracts Model with alternative pay variable (dependent variable = log total high-quality male contracts)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal	0.87389
	(0.01843)***
log_dodprodtotal	-0.02016
	(0.02840)
log_youthpop	-0.20873
	(0.05641)***
log_ur	0.29676
	(0.05922)***
log_milcivpay2	0.12233
	(0.10392)
log_vetpop	0.14409
	(0.14716)
year_2005	0.00533
	(0.01631)
year_2006	0.09078
	(0.02272)***
year_2007	0.16310
	(0.02827)***
qtr_1	-0.01765
	(0.01425)
qtr_2	0.05827
	(0.01576)***
qtr_3	0.20483
	(0.01425)***
Constant	0.57222
	(0.51765)
Observations	8047
Number of RSS1	582
R-squared	0.39

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

When comparing Table 10 to Table 8, we find the following differences. The military-civilian pay ratio maintains a positive sign in Table 10, but is not significant. In Table 8 the military-civilian pay ratio is statistically significant at the 10% level. This suggests the importance of accounting for RSS-level variation unobserved to us, which may be correlated with local pay ratios.

8. Total Contracts Supply Model without RSS Fixed Effects

The model in Table 11 is similar to that in Table 10, with the exception that it is not estimated with RSS fixed effects.

Table 11. Total Contracts Supply Model without RSS Fixed Effects (dependent variable = log total high-quality male contracts)

Variable	Estimated Coefficient (std. error)
log_usmcprodtotal	0.88636
	(0.01462)***
log_dodprodtotal	0.01468
	(0.01463)
log_youthpop	0.00825
	(0.00807)
log_ur	0.04953
	(0.02375)**
log_milcivpay2	0.16469
	(0.07291)**
log_vetpop	0.26906
	(0.03328)***
year_2005	-0.01830
	(0.01615)
year_2006	0.04338
	(0.01771)**
year_2007	0.11715
	(0.02088)***
qtr_1	-0.01911
	(0.01559)
qtr_2	0.05876
	(0.01724)***
qtr_3	0.20478
	(0.01557)***
Constant	-0.77684
	(0.13463)***
Observations	8047
R-squared	0.46

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

When comparing Table 11 to Table 10, we find the following statistically significant differences in variables: the number of other-service recruiters is not statistically significant but has a positive coefficient in Table 11 and a negative

coefficient in Table 10. Youth population no longer has a negative coefficient, nor is it statistically significant compared to Table 10. The unemployment rate is statistically significant at the 5% level in Table 11, showing a change from Table 10 where its statistical significance was at the 1% level. The military/civilian pay ratio is found to be statistically significant at the 5% level in Table 11 whereas in Table 10, it is not statistically significant. Veteran population in Table 11 has a 1% statistical significance level versus Table 10 that shows no statistical significance below the 10% level.

9. Summary of Recruiter Effects

Table 12 is a summary of the effects of Marine recruiters on high-quality male contracts, measured as elasticities, as estimated by all eight models. The Marine recruiter variable possessed the largest elasticity of any of the independent variables in the models. We have compared this variable to the elasticities in Welsh (2008).

Table 12. Summary of Marine Recruiters Elasticity

Model	Description	Marine Recruiter Elasticity	Welsh Model 2008(a)
Per Capita Model w/RSS Fixed Effects Table 4	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.8752***	.8626***
Per Capita Model w/o RSS Fixed Effects Table 5	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.8768***	.8788***
Per Capita Model w/alt. pay var. w/RSS Fixed Effects Table 6	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.8754***	.8626***
Per Capita Model w/alt. pay var. w/o RSS Fixed Effects Table 7	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.8769***	.8788***
Total Contracts Model w/RSS Fixed Effects Table 8	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.8738***	.8625***
Total Contracts Model w/o RSS Fixed Effects Table 9	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.8861***	.8890***
Total Contracts Model w/alt. pay var. w/RSS Fixed Effects Table 10	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.8738***	.8625***
Total Contracts Model w/alt. pay var. w/o RSS Fixed Effects Table 11	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.8863***	.8890***

(a)Welsh(2008)

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

In all specified models, the number of Marine recruiters was estimated to be significant at the 1% level. In this thesis the elasticity for the Marine recruiters variable ranges between .87% and .89%. Both primary models presented in Table 4 and Table 6,

show that a 10% increase in the number of Marine recruiters in the local area will increase the number of high-quality male contracts by 8.75%. This elasticity is slightly higher than those estimated by Welsh and more than double the estimate in the 2008 Navy model (Sladyk, 2008). We conclude that with the present manning of RSSs, assigning additional recruiters will increase enlistments more than any other intervention.

10. Summary of Unemployment Rate Effects

Table 13 is a summary of the elasticity of the unemployment rate on high-quality male contracts as estimated in all eight models in this thesis.

Table 13. Summary of Unemployment Rate Elasticity

Model	Description	Unemployment Rate Elasticity	Welsh Model 2008(a)
Per Capita Model (Milcivpay1) W/RSS Fixed Effects Table 4	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.0497***	.0324***
Per Capita Model (Milcivpay1) W/O RSS Fixed Effects Table 5	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.0078**	0.0049
Per Capita Model (Milcivpay2) W/RSS Fixed Effects Table 6	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.0488***	.0324***
Per Capita Model (Milcivpay2) W/O RSS Fixed Effects Table 7	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.0077**	0.0049
Total Contracts Model (Milcivpay1) W/RSS Fixed Effects Table 8	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.3039***	.2051***
Total Contracts Model (Milcivpay1) W/O RSS Fixed Effects Table 9	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.0504**	.0334*
Total Contracts Model (Milcivpay2) W/RSS Fixed Effects Table 10	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.2967***	.2051***
Total Contracts Model (Milcivpay2) W/O RSS Fixed Effects Table 11	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.0495**	.0334*

(a)Welsh(2008)

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

In all specified models in this thesis, the unemployment rate was significant at the 5% level or less. Unemployment rate elasticities range between .008% and .30%. Both primary models in Table 4 and Table 6, predict that a 10% change in the local area unemployment rate increases the number of high-quality male contracts by 0.48% to 0.49%. These elasticities are approximately 0.16 percentage points higher than those found in Welsh (2008) and a quarter of what was found in the Navy model (2.2%) (Sladyk, 2008).

11. Summary of Military-to-Civilian Pay Elasticity

Table 14 is a summary of the elasticity of the military-to-civilian pay ratio estimated by all eight models. Two alternative military-to-civilian pay ratios were used in the models. These variables are identified as milcivpay1 and milcivpay2. Milcivpay1 utilizes E1 to E3 average annual pay by year 2003 to 2007 and state-level civilian wages for 18-25-year-old males with a high school degree and no college. Milcivpay2 utilizes E1 to E3 average annual pay by year 2003 to 2007 and state-level civilian wages for 18-25-year-old males with a high school degree or some college.

Table 14. Summary of Military-to-Civilian Pay Ratio Elasticity

Model	Description	Military to Civilian Pay ratio elasticity	Welsh Model 2008(a)
Per Capita Model w/RSS Fixed Effects Table 4	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.0264*	1.0080
Per Capita Model w/o RSS Fixed Effects Table 5	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.0266**	.0683
Per Capita Model w/alt. pay var. w/RSS Fixed Effects Table 6	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.0156	1.0080
Per Capita Model w/alt. pay var. w/o RSS Fixed Effects Table 7	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.0236**	.0683
Total Contracts Model w/RSS Fixed Effects Table 8	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	.1601*	5.9743
Total Contracts Model w/o RSS Fixed Effects Table 9	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.1753***	0.5126
Total Contracts Model w/alt. pay var. w/RSS Fixed Effects Table 10	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	.1223	5.9743
Total Contracts Model w/alt. pay var. w/o RSS Fixed Effects Table 11	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.1646**	0.5126

(a)Welsh(2008)

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

The military-to-civilian pay ratio elasticity is statistically significant at less than the 10% level in all but two models and ranges between .016% and .18%. The primary models, Table 4 and Table 6, differ considerably in their estimates with the elasticity coefficient in Table 4 being larger and statistically significant. According to Table 4, a 10% change in the military-to-civilian pay ratio would result in a .26% change in high-quality male contracts. Yet, Table 6 indicates a 10% change in the military-to-civilian pay ratio would result in approximately a .16% change in high-quality male contracts. The results found in this thesis are not in the range reported in Warner (1990). Warner's (1990) report estimated a 10% change in relative pay would equate to a 5% - 25% change in high-quality enlistments all else equal. Still, Sladyk's 2008 Navy model finds a 10% change in the military-to-civilian pay ratio would result in approximately a 1.8% percent change in high-quality enlistments all else equal.

12. Summary of Other Other-Service Recruiter Effects

Table 15 shows a summary of the number of other- service recruiters on the Marine Corps' recruiting efforts to obtain high-quality male contracts.

Table 15. Summary of Other Other-Service Recruiter Elasticities

Model	Description	DOD Recruiters Elasticity	Welsh Model 2008(a)
Per Capita Model w/RSS Fixed Effects Table 4	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	0.0182	0.0336
Per Capita Model w/o RSS Fixed Effects Table 5	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	0.0161	.0316***
Per Capita Model w/alt. pay var. w/RSS Fixed Effects Table 6	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	0.0187	0.0336
Per Capita Model w/alt. pay var. w/o RSS Fixed Effects Table 7	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	0.0169	.0316***
Total Contracts Model w/RSS Fixed Effects Table 8	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	-0.0207	-0.0151
Total Contracts Model w/o RSS Fixed Effects Table 9	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	0.014	0.0203*
Total Contracts Model w/alt. pay var. w/RSS Fixed Effects Table 10	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	-0.0201	-0.0151
Total Contracts Model w/alt. pay var. w/o RSS Fixed Effects Table 11	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	0.0146	0.0203*

(a)Welsh(2008)

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Depending on how the model is specified, a 10% change in DoD recruiters will result in a -.02% or a +.18% increase in high-quality male contracts for the Marine Corps. We found that none of the eight models specified yielded statistically significant

coefficients for this variable. However, when using a per-capita model as in Tables 4 through 7), the elasticity of additional other-service recruiters, while small, are positive yet insignificant. Similar results were found in previous contract supply models by Warner (1990), Jarosz and Stephens (1999), and Hogan et al. (2000). The other services' recruiters who are co-located with Marines actually have a more positive than negative impact on the number of high-quality male contracts for the Marine Corps, perhaps due to spillover effects of information on military.

Studies by Jarosz and Stephens (1999) and Hogan et al. (2000) support the concept of complementary efforts between recruiters from different branches of service who operate within the same area (local market). Jarosz and Stephens (1999) found that in one particular local market, the number of high-quality male contracts produced by the Navy increased from 2% to 3.2% as a result of a 10% increase in Army recruiters who were recruiting there. According to Hogan et al. (2000), the number of high-quality male contracts produced by the Army increased by 0.3% when a 10% increase in Navy recruiters began recruiting in the same zip code. If a prospective applicant has a propensity to serve in the military, but favors sea duty to ground combat then joining the Navy could be considered an alternative to serving in the Army. If the Army is not considered an alternative to the Navy then the elasticity in this study would mirror the findings by Hogan et al (2000) (Welsh, 2008).

13. Summary of Veteran Population Elasticity

Table 16 is a summary of the veteran population effects on high-quality male contracts as estimated by all eight models.

Table 16. Summary of Veteran Population Elasticity

Model	Description	Veteran Population Elasticity	Welsh Model 2008
Per Capita Model w/RSS Fixed Effects Table 4	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	0.0315	N/A
Per Capita Model w/o RSS Fixed Effects Table 5	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.0400***	N/A
Per Capita Model w/alt. pay var. w/RSS Fixed Effects Table 6	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	0.0307	N/A
Per Capita Model w/alt. pay var. w/o RSS Fixed Effects Table 7	Marine Recruiters/per capita, DOD recruiters/per capita, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.0053***	N/A
Total Contracts Model w/RSS Fixed Effects Table 8	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population, RSS, Year, Qtr	0.148	N/A
Total Contracts Model w/o RSS Fixed Effects Table 9	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay1 Ratio, Veteran Population	.2715***	N/A
Total Contracts Model w/alt. pay var. w/RSS Fixed Effects Table 10	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population, RSS, Year, Qtr	0.144	N/A
Total Contracts Model w/alt. pay var. w/o RSS Fixed Effects Table 11	Marine Recruiters, DOD recruiters, Youth Population, Unemployment Rate, Military Civilian Pay2 Ratio, Veteran Population	.2690***	N/A

Standard errors in parentheses * significant at 10%;
** significant at 5%; *** significant at 1%

The veteran population coefficient was consistently positive in all models. Depending on model specification, a 1% change in veteran population resulted in a 0.03% to 0.27% increase in high-quality male contracts for the Marine Corps. The models that do not account for fixed effects show the veteran population to be statistically significant at the 1% level and have the largest magnitude. The range of increase in high-quality male contracts due to veteran population is much smaller than the elasticity of 2.1% found for the Navy in 2005 (Sladyk, 2008).

E. CHAPTER SUMMARY

Eight different specifications of a basic enlistment supply model were estimated in this study. In each model, the number of Marine recruiters has the largest impact on high-quality male applicants. With the exception of the other-service recruiter and youth population variables, the other variables, although sensitive to model specification, all had positive coefficients. In the two total contracts model specifications that used fixed effects, the coefficient for youth population was negative. Additionally, although it seems counterintuitive that a 1% increase in youth population would estimate a 0.21% decrease in high-quality male contracts produced, this could be attributed to a youth population growing disproportionately faster than the size of the USMC recruiting force at the RSS level.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSIONS

In this study we estimated high-quality male contract supply models for the Marine Corps at the Recruiting Sub-Station level. The data set used in the thesis was based on a data set initially collected by Welsh (2008). Our contribution was to incorporate new estimates of civilian youth wages that were provided to us by the Marine Corps Recruiting Command, and new estimates of state-level veteran populations taken from the American Community Survey. Model estimations were based on RSS-level data covering 14 quarters from fiscal years 2004 through 2007. Data on second quarter FY04 and fourth quarter FY07 were not available. We used a log-log functional form and estimated the models using fixed effects techniques. The results offered insight into the effects of various key predictors at the local geographic level on the production of high-quality male contracts for the Marine Corps.

We found many similarities between the coefficients in our model and those in Welsh's 2008 model. Most similar were the effects of Marine recruiters and the local area unemployment rate, which were both statistically significant and in similar in magnitude to estimates in Welsh (2008). The greatest difference in estimated coefficients between the two models was that of the military-to-civilian pay ratio. This difference in estimated coefficients is likely due to the fact that in Welsh the wage data was based on civilian manufacturing wages at the state level for males of all ages. The pay level for this demographic group is likely to systematically overstate the true opportunity cost of military enlistment to young males who are recent high school graduates. The new wage data utilized in our models was based on two different demographic groups: (1) Males aged 18 to 25 with a high school degree, no college, and working at least 20 hours per week; and (2) males, aged 18 to 25 with a high school degree or some college, and working at least a 20 hours per week.

The model created by Welsh in 2008 was used as a baseline; our goal was to improve upon its accuracy by introducing better wage data and veteran population data.

Although the new wage data was collected at the state level, it captures the age demographic which is more comparable to those individuals the Marine Corps seeks to enlist. This differs from the previous study that utilized civilian manufacturing wage data and captured the demographics ranging from age 18 to 65.

The second new variable we introduced into the enlistment supply model was an estimate of the veteran population. The veteran population is defined by the U. S. Census Bureau's annual American Community Surveys as:

> a person 18 years old or over who has served (even for a short time), but is not now serving on active duty in the U.S. Army, Navy, Air Force, Marine Corps, or the Coast Guard, or who served in the U.S. Merchant Marines during World War II.
>
> Estimates of the veteran population were compiled from the American Community Surveys for the years 2003 through 2007. The ACS data shows a steady decline of the veteran population in the U.S. during this period.

Welsh's 2008 enlistment supply study relied on state-level veteran population data from the 2000 census. Because his sample was based on the years 2003 through 2007, the veteran population variable was dropped from his model because there was no variation over time. Our data was extracted from the American Community Survey data and provided the variation in this variable over time that was previously lacking. Although the veteran population data was not statistically significant in half of our models, it did have a positive coefficient suggesting that it proxies the enlistment propensity of high-quality males.

Despite the improvements made to the Welsh 2008 model, the models we developed for this study also have a few key weaknesses that need to be addressed. First, they do not contain a variable to represent the propensity of young males to enlist in the Marine Corps. We mitigate this problem by assuming that propensities vary across RSS geographical areas, but remain fairly constant over time. Then we estimate RSS fixed effects models. Second, advertising data was not available at a Recruiting Sub-Station or Recruiting Station level. Currently, the Marine Corps Recruiting Command's advertising budget is only allocated down to the District (MCD) level. If this data were available, it

could further guide the Marine Corps on how to better invest its advertising dollars. There are numerous and obvious reasons why the Marine Corps would invest in and utilize advertising as a recruiting tool. Advertising generates awareness of the Marine Corps and what it has to offer; it attracts new applicants and potentially expands the number of poolees; and, it enables the Marine Corps to compete on a national level with private organizations and the other service branches.

While the goal of advertising are clear, the Marine Corps' ability to isolate and monetarily measure the outcome and overall effectiveness of its advertising campaigns is not so clear, especially when attempting to find a return on investment with regards to male contracts generated. The Marine Corps' advertising budget is tracked closely down to the MCD level and allocated each quarter of the fiscal year. Advertising funds disbursed to the Recruiting Station-level, however, are not set to a predetermined amount, but more on an "as needed" basis. The amount of funding each Recruiting Station requested varies and was not closely monitored in the past and is currently unavailable (WRR Advertising OIC, Phoncon 25 Oct 08). Third, the model in its current form is not usable by the average Marine and will not likely be used or maintained in a manner that reaches its full potential unless it is used by an analyst with a background and working knowledge of regression analysis.

B. RECOMMENDATIONS

The civilian wage data would be more useful for predicting the enlistment propensity of high-quality male applicants if it were collected at the county level vice state level. We recommend continuing to work with CNA in an effort to gather more samples of high-quality male applicants. The tracking of advertising data at the Recruiting Sub-Station or Recruiting Station level would be useful in determining the influence of advertising expenditures on high-quality male applicants. We recommend the manpower planners develop an optimization model to calculate the number of recruiters necessary to obtain the desired number of high-quality male contracts. We believe this can be accomplished by using the results of our fixed effects model in order

to capitalize on the effects of placing each Marine recruiter and RSS in the most productive markets (Jarosz and Stephens, 1999, p 54).

CNA civilian youth wage estimates provide more flexibility than the standard civilian earnings data retrieved from the Bureau of Labor Statistics (CNA, 2008). This is due to the fact that CNA used CPS-ORG files to estimate wages at the county level by age, gender, and education. However, it was only collected at the state level for this study because the number of young males sampled was too small at lower geographical levels (county). Our research has revealed that our civilian youth earnings variables (wage1 and wage2) have a positive effect on high-quality male contracts. However, the variation in the wage estimates is small but parameter estimates are statistically significant in six out of eight of our models.

The Marine Corps needs to hire an analyst with formal training in regression analysis to update and improve upon the contract supply models developed here. Without a thorough understanding of how to maintain, update, and interpret the models and data, the manpower planners could receive inaccurate data. The Navy has a trained civilian analyst in charge of their enlisted goaling model. This has added stability and continuity to the billet and the Navy Recruiting Command. It may be in the Marine Corps' best interest to consider following the Navy's lead.

The goal of this thesis was to produce a more dependable and user-friendly model that can be utilized by manpower planners to better forecast high-quality male applicants. Although the models developed in this study are not particularly user friendly to the average Marine, if they are updated by a trained analyst, the estimates could facilitate and focus the efforts of the recruiting force as it strives to accomplish the goal of increasing force structure over the course of the next two years.

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